

1.4 Adding and Subtracting Radical Expressions

$$\underline{2x} + \underline{3y} - 4 - \underline{x} + \underline{2y} = x + 5y - 4$$

like radicals $\underline{\sqrt{3x}} + \underline{\sqrt{3x}} = 2\sqrt{3x}$

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#5 a) $6\underline{\sqrt{2}} + 3\underline{\sqrt{2}} = 9\underline{\sqrt{2}}$

c) $7\underline{\sqrt{32}} + 4\underline{\sqrt{2}}$

$$7\underline{\sqrt{16 \cdot \sqrt{2}}} + 4\underline{\sqrt{2}}$$

$$7(4)\underline{\sqrt{2}} + 4\underline{\sqrt{2}}$$

$$28\underline{\sqrt{2}} + 4\underline{\sqrt{2}} = 32\underline{\sqrt{2}}$$

e) $3\underline{\sqrt[3]{54}} + 5\underline{\sqrt[3]{16}}$

$$3\underline{\sqrt[3]{27 \cdot \sqrt[3]{2}}} + 5\underline{\sqrt[3]{8 \cdot \sqrt[3]{2}}}$$

$$3(3)\underline{\sqrt[3]{2}} + 5(2)\underline{\sqrt[3]{2}}$$

$$9\underline{\sqrt[3]{2}} + 10\underline{\sqrt[3]{2}} = 19\underline{\sqrt[3]{2}}$$

g) $7\underline{\sqrt{63}} - 2\underline{\sqrt{28}} = 7(3)\underline{\sqrt{7}} - 2(2)\underline{\sqrt{7}} = \boxed{17\underline{\sqrt{7}}}$
 $7\underline{\sqrt{9\sqrt{7}}} - 2\underline{\sqrt{4\sqrt{7}}}$

i) $4\underline{\sqrt{12}} + 2\underline{\sqrt{27}} - 3\underline{\sqrt{75}} = 4(2)\underline{\sqrt{3}} + 2(3)\underline{\sqrt{3}} - 3(5)\underline{\sqrt{3}}$
 $4\underline{\sqrt{4\sqrt{3}}} + 2\underline{\sqrt{9\sqrt{3}}} - 3\underline{\sqrt{25\sqrt{3}}} \quad 8\underline{\sqrt{3}} + 6\underline{\sqrt{3}} - 15\underline{\sqrt{3}} = \boxed{-\underline{\sqrt{3}}}$

k) $4\underline{\sqrt{50}} + 3\underline{\sqrt{12}} - 5\underline{\sqrt{27}} = 4(5)\underline{\sqrt{2}} + 3(2)\underline{\sqrt{3}} - 5(3)\underline{\sqrt{3}}$
 $4\underline{\sqrt{25\sqrt{2}}} + 3\underline{\sqrt{4\sqrt{3}}} - 5\underline{\sqrt{9\sqrt{3}}} \quad \boxed{20\underline{\sqrt{2}} - 9\underline{\sqrt{3}}}$

m) $\underline{\sqrt{162}} - \underline{\sqrt{50}} + \underline{\sqrt{75}} - \underline{\sqrt{108}} = 9\underline{\sqrt{2}} - 5\underline{\sqrt{2}} + 5\underline{\sqrt{3}} - 6\underline{\sqrt{3}}$
 $\underline{\sqrt{81\sqrt{2}}} - \underline{\sqrt{25\sqrt{2}}} + \underline{\sqrt{25\sqrt{3}}} - \underline{\sqrt{36\sqrt{3}}} = \boxed{4\underline{\sqrt{2}} - \underline{\sqrt{3}}}$

$$0) \frac{1}{4}\sqrt{80} + \frac{2}{3}\sqrt{45} - \frac{1}{2}\sqrt{20} = 1\sqrt{5} + 2\sqrt{5} - 1\sqrt{5} = 2\sqrt{5}$$

$$2^5 \quad 9) \quad 5\sqrt[4]{32} + 2\sqrt[4]{8} \cdot \sqrt[4]{4} = 10\sqrt[4]{2} + 4\sqrt[4]{2} = 14\sqrt[4]{2} \quad \checkmark$$

$\underbrace{\phantom{2\sqrt[4]{8} \cdot \sqrt[4]{4}}}_{=32=2^5}$

$$9) \quad 5\sqrt[4]{32} + 2\sqrt[4]{8} \cdot \sqrt[4]{4}$$

$$5\sqrt[4]{32} + 2\sqrt[4]{32} = 7\sqrt[4]{32}$$

$$\downarrow$$

$$7\sqrt[4]{16\sqrt{2}}$$

$$7(2)\sqrt[4]{2} = 14\sqrt[4]{2}$$

$$0) \quad \frac{1}{4}\sqrt{80} + \frac{2}{3}\sqrt{45} - \frac{1}{2}\sqrt{20}$$

$$\frac{1}{4}\sqrt{16}\sqrt{5} + \frac{2}{3}\sqrt{9}\sqrt{5} - \frac{1}{2}\sqrt{4}\sqrt{5}$$

$$\frac{1}{\cancel{4}}(\cancel{4})\sqrt{5} + \frac{2}{\cancel{3}}(\cancel{3})\sqrt{5} - \frac{1}{\cancel{2}}(\cancel{2})\sqrt{5}$$

$$\cancel{\sqrt{5}} + 2\sqrt{5} - \cancel{\sqrt{5}} = 2\sqrt{5}$$

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#6. a) $\sqrt{3x^2} + \sqrt{12x^2}$

$$x\sqrt{3} + x\sqrt{4}\sqrt{3}$$

$$x\sqrt{3} + x(2)\sqrt{3}$$

$$3x\sqrt{3}$$

c) $\sqrt{4x^7} - 5x^2\sqrt{x^3} + 3x\sqrt{x^5}$

$$\begin{aligned} & \sqrt{4}\sqrt{x^6}\sqrt{x} - 5x^2\sqrt{x^2}\sqrt{x} + 3x\sqrt{x^4}\sqrt{x} \\ & 2x^3\sqrt{x} - 5x^2 \cdot x\sqrt{x} + 3x \cdot x^2\sqrt{x} \\ & 2x^3\sqrt{x} - 5x^3\sqrt{x} + 3x^3\sqrt{x} = \odot \end{aligned}$$

$$e) 3\sqrt{125x^2y} + 6x\sqrt{80y} = 39x\sqrt{5y}$$

$$g) 5x\sqrt{63y} + 3\sqrt{28x^2y} = 21x\sqrt{7y}$$

$$q) \sqrt{x^2-6x+9} - \sqrt{x^2-2x+1} = -2$$

$$\sqrt{(x-3)(x-3)} - \sqrt{(x-1)(x-1)}$$

$$\sqrt{(x-3)^2} - \sqrt{(x-1)^2}$$

$$(x-3) - (x-1)$$

$$\cancel{x} - 3 - \cancel{x} + 1 = -2$$

1.5 Multiplying and Dividing $\sqrt{\quad}$

$$\begin{aligned} & 3(x-2) \\ & (x-3)(x-2) \end{aligned}$$

$$3x - 6$$

$$x^2 - 2x - 3x + 6$$

$$4 \times 6 = 24$$

$$\sqrt{6} \times \sqrt{6} = 6$$

$$\sqrt{4} \times \sqrt{6} = \sqrt{24}$$

$$4 \times \sqrt{6} = 4\sqrt{6}$$

look out for difference of \square 's!

$$(\underline{x} \ominus \underline{3})(\underline{x} \oplus \underline{3}) = x^2 - 9$$

$$\#3. a) \sqrt{5}(\sqrt{8} + \sqrt{32})$$

$$= \sqrt{40} + \sqrt{160}$$

$$= \sqrt{4}\sqrt{10} + \sqrt{16}\sqrt{10}$$

$$= 2\sqrt{10} + 4\sqrt{10} = 6\sqrt{10}$$

$$c) 2\sqrt[3]{5}(3\sqrt[3]{3} - \sqrt[3]{25})$$

$$6\sqrt[3]{15} - 2\sqrt[3]{125}$$

$$6\sqrt[3]{15} - 2(5) = 6\sqrt[3]{15} - 10$$

$$g) (4 + \sqrt{3})(4 + \sqrt{3})$$

$$16 + 4\sqrt{3} + 4\sqrt{3} + 3 = 19 + 8\sqrt{3}$$

$$i) (\sqrt{5} - \sqrt{2})^2 = (\sqrt{5} - \sqrt{2})(\sqrt{5} - \sqrt{2})$$
$$5 - \sqrt{10} - \sqrt{10} + 2 = 7 - 2\sqrt{10}$$

$$\Rightarrow k) (\sqrt{5} - \sqrt{2})(\sqrt{5} + \sqrt{2})$$

$$5 - 2 = \boxed{3}$$

$$q) (\sqrt[3]{4} - 1)(\sqrt[3]{16} + \sqrt[3]{4} + 1)$$

$$\sqrt[3]{64} + \cancel{\sqrt[3]{16}} + \cancel{\sqrt[3]{4}} - \cancel{\sqrt[3]{16}} - \cancel{\sqrt[3]{4}} - 1$$

$$4 - 1 = 3$$

$$l) \left(\frac{5 - \sqrt{50}}{5} \right)^2 \rightarrow \left(\frac{\cancel{5} - \cancel{5}\sqrt{2}}{\cancel{5}} \right)^2 = (1 - \sqrt{2})^2$$

$$(1 - \sqrt{2})(1 - \sqrt{2}) = 1 - \sqrt{2} - \sqrt{2} + 2 \\ = 3 - 2\sqrt{2}$$

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#4.

$$c) (\underline{2x} \ominus \underline{\sqrt{3}})(\underline{2x} \oplus \underline{\sqrt{3}})$$

$$\rightarrow 4x^2 - 3$$

$$g) (\sqrt{x-3} - 4)^2 (\sqrt{x-3} - 4)$$

$$x - 3 - 4\sqrt{x-3} - 4\sqrt{x-3} + 16$$

$$x + 13 - 8\sqrt{x-3}$$

$$i) (3\sqrt{x} + \sqrt{y})^2$$

$$(3\sqrt{x} + \sqrt{y})(3\sqrt{x} + \sqrt{y}) = 9x + 3\sqrt{xy} + 3\sqrt{xy} + y \\ = 9x + y + 6\sqrt{xy}$$

$$\Rightarrow o) (\underline{\sqrt{y+1}} \oplus \underline{\sqrt{y-1}})(\underline{\sqrt{y+1}} \ominus \underline{\sqrt{y-1}})$$

$$y + 1 - (y - 1) = \boxed{2}$$

$$k) (\sqrt{x}-2)^2 - (\sqrt{x}+2)^2$$

$$(\sqrt{x}-2)(\sqrt{x}-2) - (\sqrt{x}+2)(\sqrt{x}+2)$$

$$x - 2\sqrt{x} - 2\sqrt{x} + 4 - (x + 2\sqrt{x} + 2\sqrt{x} + 4)$$

$$\cancel{x} - 4\sqrt{x} + \cancel{4} - \cancel{x} - 4\sqrt{x} - \cancel{4} = -8\sqrt{x}$$

$$r) (\sqrt[3]{x} + 1)(\sqrt[3]{x^2} - \sqrt[3]{x} + 1) \quad A: x+1$$

And now for dividing!

Rationalizing the denominator

- making rational
- getting rid of $\sqrt{\quad}$

warm up:

$$\sqrt{6} \times \sqrt{6} = 6$$

$$\sqrt{2} \times \sqrt{2} = 2$$

$$\sqrt{-i} \times \sqrt{-i} = -i$$

$$\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$$

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#9.

$$a) \frac{1}{\sqrt{2}} \left(\frac{\sqrt{2}}{\sqrt{2}} \right) = \frac{\sqrt{2}}{2}$$

$$c) \frac{3+\sqrt{2}}{\sqrt{2}} \left(\frac{\sqrt{2}}{\sqrt{2}} \right) = \frac{3\sqrt{2}+2}{2}$$

$$d) \frac{5-\sqrt{2}}{\sqrt{3}} \left(\frac{\sqrt{3}}{\sqrt{3}} \right) = \frac{5\sqrt{3}-\sqrt{6}}{3}$$

ex. $\underbrace{\sqrt{3}+2 \quad \sqrt{3}-2}_{\text{conjugate}}$

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$$a) (\sqrt{5}+2)(\sqrt{5}-2) = 5-4 = 1$$

$$b) 1$$

$$c) 13$$

$$d) x-y^2$$

$$e) x-y$$

$$f) x$$

$$g) x-y$$

$$h) x^2-x+1$$

$$i) 2-2x$$

$$j) 6$$

$$9. e) \frac{1}{3+\sqrt{2}} \left(\frac{3-\sqrt{2}}{3-\sqrt{2}} \right) = \frac{3-\sqrt{2}}{9-2} = \frac{3-\sqrt{2}}{7}$$

$$g) \frac{\sqrt{12}}{\sqrt{3}+1} \left(\frac{\sqrt{3}-1}{\sqrt{3}-1} \right) = \frac{\sqrt{36}-\sqrt{12}}{3-1} = \frac{\overset{3}{\cancel{6}} - \cancel{2}\sqrt{3}}{\cancel{2}}$$

$$\frac{\cancel{2}(3-\sqrt{3})}{\cancel{2}}$$

$$3-\sqrt{3}$$

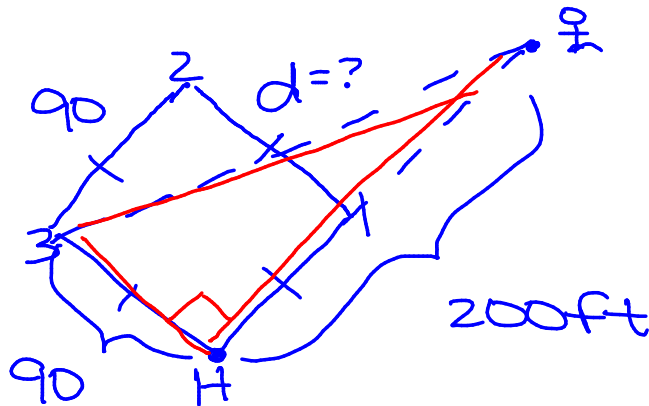
$$i) \frac{3+\sqrt{2}}{1+\sqrt{2}} \left(\frac{1-\sqrt{2}}{1-\sqrt{2}} \right) = \frac{1-2\sqrt{2}}{-1} = 2\sqrt{2}-1$$

$$j) \frac{\sqrt{5}}{\sqrt{2}-\sqrt{3}} \left(\frac{\sqrt{2}+\sqrt{3}}{\sqrt{2}+\sqrt{3}} \right) = \frac{\sqrt{10}+\sqrt{15}}{-1} = -\sqrt{10}-\sqrt{15}$$

$$k) \frac{1}{\sqrt{x}-\sqrt{y}} \left(\frac{\sqrt{x}+\sqrt{y}}{\sqrt{x}+\sqrt{y}} \right) = \frac{\sqrt{x}+\sqrt{y}}{x-y}$$

$$l) \frac{\sqrt{a}+b}{\sqrt{a}-b} \left(\frac{\sqrt{a}+b}{\sqrt{a}+b} \right) = \frac{a+2b\sqrt{a}+b^2}{a-b^2}$$

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17.



pythag:

$$d = \sqrt{90^2 + 200^2} = \sqrt{48100} = \sqrt{481} \sqrt{100} = 10\sqrt{481} \text{ ft}$$

12.

$$V = \frac{4}{3}\pi r^3 \quad V = 36 \text{ cm}^3$$

$$r = ?$$

$$36 = \frac{4}{3}\pi r^3$$

$$\frac{3}{4} (36) = \pi r^3$$

$$27 = \pi r^3$$

$$\sqrt[3]{\frac{27}{\pi}} = \sqrt[3]{r^3}$$

$$r = \frac{3}{\sqrt[3]{\pi}} \text{ cm}$$

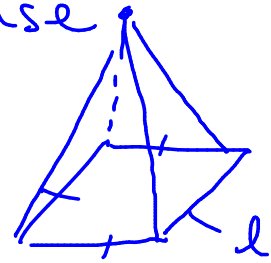
$$r = 2.04 \text{ cm}$$

14. $V = \frac{1}{3} Bh$ $B = \text{area of base}$

$$V = 300 \text{ m}^3$$

$$h = 9 \text{ m}$$

length of one
side of base = ?



$$300 = \frac{1}{3} B (9)$$

$$300 = 3B$$

$$100 = B$$

$$l = \sqrt{B} = 10 \text{ m}$$

